

completed in the processing routine of FIG. 12. The data on the remaining quantities of inks are written into the RAM 210 incorporated in the control IC 200 by an interruptive routine, which is activated at a different timing from the timing of the writing operation into the RAM 44. In this arrangement, the latest data on the remaining quantities of inks are kept on the RAM 44. Another possible modification backs up the contents of storage in the RAM 210 of the control IC 200 by means of a battery or a mass storage capacitor. The RAM 210 may be replaced with an EEPROM. The contents of storage in the EEPROM 90 incorporated in the printer main body 100 may not be completely coincident with the contents of storage in the RAM 210 of the control IC 200. Other pieces of information required for the control procedure as well as the pieces of information relating to the ink cartridges 107K and 107F are written into the EEPROM 90, whereas only the information relating to the ink cartridges 107K and 107F are written into the RAM 210 of the control IC 200.

The present invention is not restricted to the above embodiments or their modifications, but there may be many other modifications, changes, and alterations without departing from the scope or spirit of the main characteristics of the present invention. For example, dielectric memories (FROM) may replace the memory cells 81 in the storage elements 80 and the EEPROM 90.

The information relating to the quantities of inks indicates the remaining quantities of inks in the above embodiments, but may indicate the amounts of ink consumption instead. The storage elements 80 may not be incorporated in the respective ink cartridges 107K and 107F, but may be exposed to the outside. FIG. 16 shows a color ink cartridge 500 having an exposed storage element. The ink cartridge 500 includes a vessel 51 substantially formed in the shape of a rectangular parallelepiped, a porous body (not shown) that is impregnated with ink and accommodated in the vessel 51, and a cover member 53 that covers the top opening of the vessel 51. The vessel 51 is parted into five ink chambers (like the ink chambers 107C, 107LC, 107M, 107LM, and 107Y in the ink cartridge 107F discussed in the above embodiments), which separately keep five different color inks. Ink supply inlets 54 for the respective color inks are formed at specific positions on the bottom face of the vessel 51. The ink supply inlets 54 at the specific positions face ink supply needles (not shown here) when the ink cartridge 500 is attached to a cartridge attachment unit of a printer main body (not shown here). A pair of extensions 56 are integrally formed with the upper end of an upright wall 55, which is located on the side of the ink supply inlets 54. The extensions 56 receive projections of a lever (not shown here) fixed to the printer main body. The extensions 56 are located on both side ends of the upright wall 55 and respectively have ribs 56a. A triangular rib 57 is also formed between the lower face of each extension 56 and the upright wall 55. The vessel 51 also has a check recess 59, which prevents the ink cartridge 500 from being attached to the unsuitable cartridge attachment unit mistakenly.

The upright wall 55 also has a recess 58 that is located on the substantial center of the width of the ink cartridge 500. A circuit board 31 is mounted on the recess 58. The circuit board 31 has a plurality of contacts, which are located to face contacts on the printer main body, and a storage element (not shown) mounted on the rear face thereof. The upright wall 55 is further provided with projections 55a and 55b and extensions 55c and 55d for positioning the circuit board 31.

The ink cartridge 500 of this structure also enables the data on the remaining quantities of inks to be stored into the

storage element provided on the circuit board 31, as in the embodiments discussed above.

The above embodiments use the five color inks, magenta, cyan, yellow, light cyan, and light magenta, as the color inks kept in the color ink cartridge 107F. The principle of the present invention is also applicable to another ink cartridge, in which six or more different color inks are kept. The present invention is further applicable to the structure in which the ink cartridges are set to the printer main body 100, as well as to the structure in which the ink cartridges are mounted on the carriage 101.

The scope and spirit of the present invention are limited only by the terms of the appended claims.

What is claimed is:

1. (Amended) A printer having a printer main body, to which a cartridge is detachably attached, said cartridge keeping ink therein and having a rewritable non-volatile memory, wherein the ink kept in said cartridge is transferred to a printing medium, so as to implement printing, said printer comprising:

a memory writing unit that writes plural pieces of information relating to said cartridge into said rewritable non-volatile memory of said cartridge [at a preset timing and thereby at a certain frequency];

a rewritable storage device incorporated in said printer main body of said printer; and

an information writing unit that writes specific information into said rewritable storage device of said printer main body [at a specified frequency that is higher than the certain frequency, at which the plural pieces of information relating to said cartridge are written] more frequently than the memory writing unit writes information into said non-volatile memory of said cartridge, the specific information being identical with at least part of the plural pieces of information relating to said cartridge.

2. A printer in accordance with claim 1, wherein said information writing unit writes the specific information into said rewritable storage device of said printer main body at the preset timing as well as at another timing.

3. (Amended) A printer in accordance with either one of claims 1 and 2, said printer further comprising:

a print head that is mounted on [a] said printer main body of said printer,

wherein said cartridge is detachably attached to a carriage, on which said print head is mounted and which moves forward and backward relative to said printing medium, and

said storage device of said printer main body is disposed on said carriage.

4. A printer in accordance with claim 1, wherein said memory writing unit writes the plural pieces of information into said rewritable non-volatile memory of said cartridge at a power-off time of said printer and/or at a time of replacement of said cartridge.

5. A printer in accordance with any one of claims 1 through 3, wherein said information writing unit writes the specific information into said rewritable storage device on completion of printing with regard to one page.

6. A printer in accordance with any one of claims 1 through 5, wherein said information writing unit writes the specific information into said rewritable storage device on completion of printing with regard to at least one raster line.

7. (Amended) A printer in accordance with any one of claims 1 through 6, said printer further comprising:

a print head that is mounted on [a] said printer main body of said printer; and

a cleaning unit that is activated in response to a predetermined operation, so as to carry out a head cleaning process, which causes said print head to eject a predetermined quantity of ink,

wherein said information writing unit writes the specific information into said rewritable storage device at a timing when said cleaning unit is activated.

8. A printer in accordance with claim 1, wherein said non-volatile memory transmits data by serial access, and said memory writing unit writes the plural pieces of information into said non-volatile memory of said cartridge in synchronism with a clock for specifying an address.

9. A printer in accordance with claim 1, wherein said rewritable storage device of said printer main body is a non-volatile memory that holds contents of storage even after a power-off operation of said printer.

10. A printer in accordance with claim 1, wherein a writing rate of said rewritable storage device of said printer main body is higher than a writing rate of said rewritable non-volatile memory of said cartridge.

11. A printer in accordance with claim 10, wherein said rewritable storage device of said printer main body is either a DRAM or an SRAM.

12. A printer in accordance with either one of claims 9 and 11, wherein said rewritable storage device of said printer main body is disposed in a control IC, which directly controls the writing operation of the plural pieces of information into said non-volatile memory of said cartridge.

13. (Amended) A printer in accordance with claim 12, said printer further comprising:

a print head that is mounted on [a] said printer main body of said printer,

wherein said cartridge is detachably attached to a carriage, on which said print head is mounted and which moves forward and backward relative to said printing medium,

said control IC is disposed on said carriage, and

said control IC on said carriage transfers data to be written into said non-volatile memory from said printer main body to said cartridge via a cable connecting with said carriage.

14. A printer in accordance with claim 1, wherein both a black ink cartridge that keeps black ink and a color ink cartridge that keeps a plurality of different color inks are detachably attached to said printer as said cartridge, and

said memory writing unit writes the plural pieces of information into non-volatile memories, which are respectively provided in said black ink cartridge and said color ink cartridge.

15. A printer in accordance with claim 1, wherein said memory writing unit writes the plural pieces of information into said non-volatile memory of said cartridge, before said information writing unit writes the specific information into said rewritable storage device of said printer main body.

16. A printer in accordance with claim 1, wherein said memory writing unit writes the plural pieces of information into said non-volatile memory of said cartridge, after the writing operation of said information writing unit into said rewritable storage device of said printer main body is completed.

17. A printer in accordance with claim 1, said printer further comprising:

an identification unit that determines whether or not contents of storage in said non-volatile memory of said cartridge are coincident with contents of storage in said rewritable storage device of said printer main body at a time of power supply to said printer and/or at a time of initiating a replacement of said cartridge; and

a reconciliation unit that reconciles the contents of storage in one of said non-volatile memory and said rewritable storage device with the contents of storage in the other of said non-volatile memory and said rewritable storage device, in the case where said identification unit determines that the contents of storage in said non-volatile memory are not coincident with the contents of storage in said rewritable storage device.

18. A method of managing information in a printer, to which a cartridge is detachably attached, said cartridge keeping ink therein and having a rewritable nonvolatile memory, wherein the ink kept in said cartridge is transferred to a printing medium, so as to implement printing, said method comprising the steps of:

writing plural pieces of information relating to said cartridge into said rewritable non-volatile memory of said cartridge at a preset timing and thereby at a certain frequency; and

writing specific information into a rewritable storage device incorporated in said printer main body of said printer at a specified frequency that is higher than the certain frequency, at which the plural pieces of information relating to said cartridge are written into said non-volatile memory of said cartridge, the specific information being identical with at least part of the plural pieces of information relating to said cartridge.

19. (Amended) A cartridge keeping ink therein and having a rewritable non-volatile memory, said cartridge [being] configured to be detachably attached to a printer,

wherein information relating to said cartridge is written into said non-volatile memory of said cartridge [at a certain frequency that is lower than a specified frequency, at which] less frequently than the information relating to said cartridge is written into a storage device incorporated in a printer main body of said printer,

and wherein the information is written into said non-volatile memory in response to a power down instruction occurred in the printer main body.

20. A cartridge in accordance with claim 19, wherein the information relating to said cartridge is written into said non-volatile memory of said cartridge at a power-off time of said printer and/or at a time of replacement of said cartridge.

21. A cartridge in accordance with claim 19, wherein said non-volatile memory transmits data by serial access, and the writing operation of the information relating to said cartridge into said non-volatile memory is carried out synchronously with a clock for specifying an address.

22. A cartridge in accordance with claim 19, wherein the information relating to said cartridge is written into said non-volatile memory of said cartridge, before the information is written into said storage device of said printer main body.

23. A cartridge in accordance with claim 19, wherein the information relating to said cartridge is written into said non-volatile memory of said cartridge, after the writing operation of the information into said storage device of said printer main body is completed.

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24. A cartridge in accordance with claim 19, said cartridge comprising:

an ink reservoir, in which a plurality of different inks are kept,

wherein plural pieces of information with regard to the plurality of different inks are written into said non-volatile memory of said cartridge.

25. A cartridge in accordance with claim 24, wherein said ink reservoir is parted into at least three ink chambers, in which at least three different inks are kept,

wherein said non-volatile memory comprises a plurality of information storage areas, in which plural pieces of information regarding quantities of the at least three different inks are stored respectively and independently, and

a storage capacity of at least one byte is allocated to each of the plurality of information storage areas.

26. A cartridge in accordance with claim 24, wherein said ink reservoir is parted into at least five ink chambers, in which at least five different inks are kept,

wherein said non-volatile memory comprises a plurality of information storage areas, in which plural pieces of information regarding quantities of the at least five different inks are stored respectively and independently, and

a storage capacity of at least one byte is allocated to each of the plurality of information storage areas.

27. A cartridge in accordance with claim 26, wherein the at least five different inks comprise three deep color inks and two light color inks, which correspond to two deep colors among the three deep color inks,

the information storage areas for storing pieces of information regarding the three deep color inks being located in a first area that is written first by said printer, and the information storage areas for storing pieces of information regarding the two light color inks being located in a second area that is written next by said printer.

28. A cartridge in accordance with claim 27, wherein the three deep color inks are cyan, magenta, and yellow, and the two light color inks are light cyan and light magenta.

29. A cartridge in accordance with claim 24, wherein said non-volatile memory has a specific writing area, in which the plural pieces of information are written, on one end of a memory space thereof.

30. A cartridge in accordance with claim 19, wherein said non-volatile memory is an EEPROM.

31. (New) A cartridge in accordance with claim 19, wherein the power down instruction occurs when

(1) a power switch of the printer is turned down;

(2) a cartridge switch is operated to give an instruction of replacing the ink cartridge; and

(3) a power supply to the printer main body is forcibly cut off by pulling a power plug.

32. (New) A printer having a printer main body, to which a cartridge is detachably attached, said cartridge keeping ink therein and having a rewritable non-volatile memory, wherein the ink kept in said cartridge is transferred to a printing medium, so as to implement printing, said printer comprising:

memory writing means for writing information relating to said cartridge into said rewritable non-volatile memory of said cartridge;

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means for storing data which can be rewritten, said means for storing data being incorporated in said printer main body of said printer, and

information writing means for writing specific information into said means for storing data more frequently than the memory writing means writes information into said non-volatile memory of said cartridge, the specific information being identical with at least part of the information relating to said cartridge.

33. (New) A printer in accordance with claim 32, wherein said information writing means writes the specific information into said means for storing data of said printer main body at the preset timing as well as at another timing.

34. (New) A printer in accordance with either one of claims 32 and 33, said printer further comprising:

printing means mounted on said printer main body of said printer for printing on the printing medium,

wherein said cartridge is detachably attached to a carriage, on which said printing means is mounted and which moves forward and backward relative to said printing medium, and

said means for storing data of said printer main body is disposed on said carriage.

35. (New) A printer in accordance with claim 32, wherein said memory writing means writes the plural pieces of information into said rewritable non-volatile memory of said cartridge at a power-off time of said printer and/or at a time of replacement of said cartridge.

36. (New) A printer in accordance with any one of claims 32 through 35, wherein said information writing means writes the specific information into said means for storing data of said printer main body on completion of printing with regard to one page.

37. (New) A printer in accordance with any one of claims 32 through 36, wherein said information writing means writes the specific information into said means for storing data of said printer main body on completion of printing with regard to at least one raster line.

38. (New) A printer in accordance with any one of claims 32 through 37, said printer further comprising:

printing means mounted on said printer main body of said printer for printing on the printing medium; and

cleaning means, activated in response to a predetermined operation, for cleaning said printing means,

wherein said information writing means writes the specific information into said means for storing data at a timing when said cleaning means is activated.

39. (New) A printer in accordance with claim 32, wherein said non-volatile memory transmits data by serial access, and

said memory writing means writes the plural pieces of information into said non-volatile memory of said cartridge in synchronism with a clock for specifying an address.

40. (New) A printer in accordance with claim 32, wherein said means for storing data of said printer main body is a non-volatile memory that holds contents of storage even after a power-off operation of said printer.

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41. (New) A printer in accordance with claim 32, wherein a writing rate of said means for storing data of said printer main body is higher than a writing rate of said rewritable non-volatile memory of said cartridge.

42. (New) A printer in accordance with claim 41, wherein said means for storing data of said printer main body is either a DRAM or an SRAM.

43. (New) A printer in accordance with either one of claims 40 and 42, wherein said means for storing data of said printer main body is disposed in a control IC, which directly controls the writing operation of the plural pieces of information into said non-volatile memory of said cartridge.

44. (New) A printer in accordance with claim 43, said printer further comprising:

printing means mounted on said printer main body of said printer for printing on the printing medium,

wherein said cartridge is detachably attached to a carriage, on which said printing means is mounted and which moves forward and backward relative to said printing medium,

said control IC is disposed on said carriage, and

said control IC on said carriage transfers data to be written into said non-volatile memory from said printer main body to said cartridge via a cable connecting with said carriage.

45. (New) A printer in accordance with claim 32, wherein both a black ink cartridge that keeps black ink and a color ink cartridge that keeps a plurality of different color inks are detachably attached to said printer as said cartridge, and

said memory writing means writes the plural pieces of information into non-volatile memories, which are respectively provided in said black ink cartridge and said color ink cartridge.

46. (New) A printer in accordance with claim 32, wherein said memory writing means writes the plural pieces of information into said non-volatile memory of said cartridge, before said information writing means writes the specific information into said means for storing data of said printer main body.

47. (New) A printer in accordance with claim 32, wherein said memory writing means writes the plural pieces of information into said non-volatile memory of said cartridge, after the writing operation of said information writing means into said means for storing data of said printer main body is completed.

48. (New) A printer in accordance with claim 32, said printer further comprising:

identification means for determining whether or not contents of storage in said non-volatile memory of said cartridge are coincident with contents of storage in said means for storing data of said printer main body at a time of power supply to said printer and/or at a time of initiating a replacement of said cartridge; and

reconciliation means for reconciling the contents of storage in one of said non-volatile memory and said means for storing data of said printer main body with the contents of storage in the other of said non-volatile memory and said means for storing data of said printer main body, in the case where said identification means determines that the contents of storage in said non-volatile memory are not coincident with the contents of storage in said means for storing data of said printer main body.

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49. (New) A cartridge keeping ink therein and having a rewritable non-volatile memory, said cartridge for detachably attaching to a printer,

wherein information relating to said cartridge is written by a means for writing information into said non-volatile memory of said cartridge less frequently than the information relating to said cartridge is written into a storage device incorporated in a printer main body of said printer, and

wherein the means for writing writes the information into said non-volatile memory in response to a power down instruction occurred in the printer main body.

50. (New) A cartridge in accordance with claim 49, wherein the means for writing writes the information relating to said cartridge into said non-volatile memory of said cartridge at a power-off time of said printer and/or at a time of replacement of said cartridge.

51. (New) A cartridge in accordance with claim 49, wherein said non-volatile memory transmits data by serial access, and the writing operation of the information relating to said cartridge into said non-volatile memory is carried out by the means for writing synchronously with a clock for specifying an address.

52. (New) A cartridge in accordance with claim 49, wherein the means for writing writes the information relating to said cartridge into said non-volatile memory of said cartridge, before the information is written into said storage device of said printer main body.

53. (New) A cartridge in accordance with claim 49, wherein the means for writing writes the information relating to said cartridge is written into said non-volatile memory of said cartridge, after the writing operation of the information into said storage device of said printer main body is completed.

54. (New) A cartridge in accordance with claim 49, said cartridge comprising:

ink storing means for storing a plurality of different inks,

wherein plural pieces of information with regard to the plurality of different inks are written by said means for writing into said non-volatile memory of said cartridge.

55. (New) A cartridge in accordance with claim 54, wherein said ink storing means is parted into at least three ink chambers, in which at least three different inks are kept,

wherein said non-volatile memory comprises a plurality of information storage areas, in which plural pieces of information regarding quantities of the at least three different inks are stored respectively and independently, and

a storage capacity of at least one byte is allocated to each of the plurality of information storage areas.

56. (New) A cartridge in accordance with claim 54, wherein said ink storing means is parted into at least five ink chambers, in which at least five different inks are kept,

wherein said non-volatile memory comprises a plurality of information storage areas, in which plural pieces of information regarding quantities of the at least five different inks are stored respectively and independently, and

a storage capacity of at least one byte is allocated to each of the plurality of information storage areas.

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57. (New) A cartridge in accordance with claim 56, wherein the at least five different inks comprise three deep color inks and two light color inks, which correspond to two deep colors among the three deep color inks.

the information storage areas for storing pieces of information regarding the three deep color inks being located in a first area that is written first by said printer, and the information storage areas for storing pieces of information regarding the two light color inks being located in a second area that is written next by said printer.

58. (New) A cartridge in accordance with claim 57, wherein the three deep color inks are cyan, magenta, and yellow, and the two light color inks are light cyan and light magenta.

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59. (New) A cartridge in accordance with claim 56, wherein said non-volatile memory has a specific writing area, in which the plural pieces of information are written, on one end of a memory space thereof.

60. (New) A cartridge in accordance with claim 49, wherein said non-volatile memory is an EEPROM.

61. (New) A cartridge in accordance with claim 49, wherein the power down instruction occurs when

(1) a power switch of the printer is turned down;

(2) a cartridge switch is operated to give an instruction of replacing the ink cartridge; and

(3) a power supply to the printer main body is forcibly cut off by pulling a power plug.

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